Ph.D. Title Proposal

on

Design and Development of an AI-Driven Privacy Preserving System for Personalized Financial Wellness

Submitted in partial fulfillment of the requirement
for the award of the Degree of

Doctor of Philosophy
in
Computer Engineering

by

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under the guidance of

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January 2025

PROPOSAL FOR TOPIC APPROVAL TO BE SUBMITTED TO THE UNIVERSITY OF MUMBAI FOR THE DEGREE OF **Ph.D. (SCIENCE AND TECHNOLOGY)** IN THE SUBJECT OF **COMPUTER ENGINEERING**

Title of Topic	:	Design and Development of an AI-Driven Privacy Preserving System for Personalized Financial Wellness
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In the Case of Ph.D. student Year of Passing of PET/NET/SET/GATE (Teaching Experience)	:	PET - 2022
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Sr. No.	Contents	Page No.
1	Introduction	1
2	Research Hypothesis	4
3	Aim & Objectives	4
4	Materials & Methods	5
5	Expected Results / Outcome	7
6	References	8

Statement by the Candidate

I wish to state that the work embodied in this synopsis titled "Design and Development of an AI-Driven Privacy Preserving System for Personalized Financial Wellness" forms my own contribution to the work carried out under the guidance of Dr. Vidyullata Devmane at the Shah and Anchor Kutchhi Engineering College. I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.

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Introduction

In today's rapidly evolving financial landscape personalized financial management has become a critical aspect of overall well-being. Effective planning to manage finance is essential and decision making is equally as important to cope with uncertainties. Many individuals still in trouble when it comes to finance skills due to lack of awareness, insufficient financial literacy. Even though there are various digital tools available, most of them are one size fits all and do not include flexible personalized solutions for different issues to address diverse financial needs. This highlights the importance of developing innovative approach which integrate advanced Artificial Intelligence (AI) techniques with user centric approach.

The emergence of AI are now changing every field including finance. However, the use of AI for personal financial management has yet to be addressed towards designing effective approaches which cater for the competing needs of user data protection, personalization of the experience. This is a great challenge for most developing countries like India where finances and tools for their management are not as accessible or user friendly.

This study seeks to mitigate these issues through the design and development of an AI-driven system that is able to generate personalized investment plans without compromising on the user data privacy. The proposed system will analyze the available financial information to discover relevant insights and provide appropriate suggestions that assist users to achieve their defined financial goals.

Considerable effort will be directed at designing the system to be user friendly and simple so that users with diverse financial knowledge can make use of it. With the integration of privacy preserving methods the study will guarantee the protection of confidential information of users which will enhance trust and adequacy. This work not only fills certain gaps in the literature but also seeks to respond to real world problems, addressing the needs of people trying to better their financial position in today's turbulent economy.

Federated learning is used to maintain data privacy and enables collaborations among organizations to work together. Peng et al. [1] introduced the concept of Federated Meta Embedding to improve precision for stock recommendations by maintaining privacy and integrating public financial data and private investor forum data from diverse sources. Similarly, Chatterjee et al. [2] demonstrated practical application of federated learning in financial recommendation systems to offer personalized recommendations with data privacy. Wu et al. [3] proposed a federated deep learning framework for privacy preserving recommendations and also adapted for financial services. Banabilah et al. [4] reviewed federated learning and explored opportunities to develop scalable financial models that maintain user privacy.

Advanced AI techniques like machine learning and deep learning are used to improve financial decision making processes. Mu et al. [5] improved the accuracy of stock price especially during market volatility by combining historical stock data and investor sentiment data from news and social media. In order to balance risk and profit, Zhang et al. [6] constructed a multi- objective recommendation model for P2P (peer-to-peer) lending that focused on maximizing AI capabilities in mitigating potential financial risks by ensuring a balance between risk and return. In the same manner, Ambuli et al. [7] applied machine learning techniques for investment portfolio selection and optimization by picking the best investment assets based on available data and trends. Ricchiuti et al. [8] used LSTM networks on time-series data to predict stock movements, thus proving deep learning can be used to analyze historical price trends and formulate deep forecasts on stock prices. Khattak et al. [9] contributed by reviewing various machine learning algorithms for market trend analysis and profitability, illustrating the pros and cons of using these techniques to predict financial performance.

Graph-based models have gained attention due to their ability to represent complex relationships among financial instruments. Hsu et al. [10] introduced a Financial Graph Attention Network where the features that relate to market sentiment and financial trends are taken into account, thereby making stock recommendations more accurate. Chou et al. [11] proposed an approach for personalized fund recommendations using graphical deep collaborative filtering.

The use of explainable artificial intelligence (XAI) is essential for boosting the trustworthiness and openness of AI assisted financial decisions. Lai et al. [12] demonstrated NLP and XAI that could help interpret the climate risk financial statements, increasing the openness and assurance of AI enabled financial services, especially where sensitive climate data needs to be considered for investment decisions. Sharma et al. [13] discussed trade-offs between the two distinct but complementary aspects of privacy and utility in AI investment strategies, focusing on how AI could achieve the balance between managing privacy and enhancing investment returns. Zhu et al. [14] analyzed AI features in financial moderators and noted more focus on individual recommendations where the advice is tailored to the client's needs. Marchev et al. [15] elaborated on the use of AI in personal preference based investment strategies optimization, which adds value to the client oriented financial service provisions. Shafiee et al. [16] worked with the term personal financial configurators by focusing on AI advice to enhance the financial decision making processes and the level of understanding. Moreover, Ablazov et al. [17] investigated the provision of AI powered robo advisors that develop investment portfolios through the utilization of artificial intelligence algorithms at a lower cost than the traditional financial advisory. Pangavhane et al. [18] received attention as well for the development of AI based personal finance advisors that take over budgeting, expense, and investment automation and decision making to change personal finances. Uyanahewa et al. [19] dealt with the implementation of a machine learning system into the management of personal finances through predictive analysis and expense tracking for better decision making. Sharaf et al. [20] discussed the integration of recommendation systems within the financial services and the different collaborative, content based, and hybrid models of AI.

AI is also being introduced extensively in the management of risks and in the detection of fraud in the financial systems. Gonzales et al. [21] developed an AI-based investment decision support system for stock selection and risk management by incorporating machine learning and data mining techniques to enhance stock picking processes and reduce financial exposure. Gao et al. [22] studied the applications of machine learning for business and finance, such as fraud detection and credit schemes, consequently demonstrating how AI integrates with finance to make practices more efficient by providing accurate and real-time solutions. Nazareth et al. [23] conducted a detailed review of the literature involving applications of machine learning within the boundaries of finance, covering issues like credit scoring, fraud detection, and portfolio investment management.

Generative AI models have started gaining importance in the context of economic and financial scenario generation. Zheng et al. [24] suggested the adoption of generative models for the economic and financial scenarios generation, emphasizing their role in strengthening the financial model infrastructure for stress-test and economic system forecasting.

The implementation of AI technologies in financial decision making should take into consideration potential privacy implications and its actual merits. Sharma et al. [13] studied the balance between privacy and utility in privacy-protected AI-based investment strategies to safeguard privacy while enhancing investment activities. Wilson et al. [25] suggested understanding the clients' financial goals and risk tolerance, regarding investments in private property and real estate investment trusts (REITs), and point out where the ethical implication of such activity in the financial AI comes into focus.

The possibilities of AI are endless within the application of finance. Bhatt et al. [26] reviewed some of the areas AI has the ability to intervene like fraud detection and customer support, along with portfolio management and blockchain. Furthermore, Ren [27] explained how investment decision

processes are affected by AI algorithms by proving forecasting of asset prices and market analysis could be achieved much easier through AI technologies.

Use of AI techniques is gaining advantage in estimating credit risk and developing credit portfolios. Amato et al. [28] demonstrated the ability of AI in credit portfolio management from the point of view of machine learning in optimizing credit risk assessment, customer focus, and portfolio performance. Cao [29] reviewed AI techniques in economics, such as machine learning, deep learning, natural language processing, in context of the use of AI for problems of data privacy and model interpretability in the financial world.

Trust, the degree of transparency, and personalization influence the acceptance and adoption of AI-based financial services. Chua et al. [30] explored the increasing appetite for AI-based investment advice and the primary determinants of user acceptance of such services. Wen et al. [31] emphasized further the need for federated learning and its secure and decentralized data processing particularly in sensitive areas such as finance where trust and user adoption is at stake. Qiu et al. [32] worked on a more sophisticated problem by formulating a two stage hybrid framework through variational mode decomposition and applying residual correction techniques to increase gold price predictions and to improve the gold price prediction over the traditional single models. Wang et al. [33] developed recommendation system which operates on the Federated Learning with meta-learning for personalized recommendation and user level differential privacy to reinforce the model with privacy.

Research Hypothesis

An AI-driven privacy preserving platform can analyze financial data to provide personalized investment strategies while ensuring the privacy of user data through a user friendly platform.

Aim & Objectives

The aim of this study is to develop an AI-Driven system that analyzes financial data to identify patterns within it, generates personalized investment strategies while ensuring data privacy, and facilitates better financial planning through a simple and user friendly interface for user with varying levels of financial literacy.

The objectives of this study are outlined as follows:

- To analyze and categorize financial data to identify significant patterns in personal financial practices.
- To securely process user data using privacy preserving technique, ensuring the confidentiality of sensitive financial information.
- To develop and train AI-based model capable of generating personalized investment strategies tailored to individual financial data.
- To evaluate user experience and satisfaction with the AI-driven platform, ensuring its intuitiveness and accessibility for users across different financial literacy levels.

Materials & Methods

The methodology is described in the block diagram given below. It shows key components of the system and how they integrate, starting from collecting data to giving recommendations. Each block corresponds to a step in the process, offering a simplified overview of the system workflow.

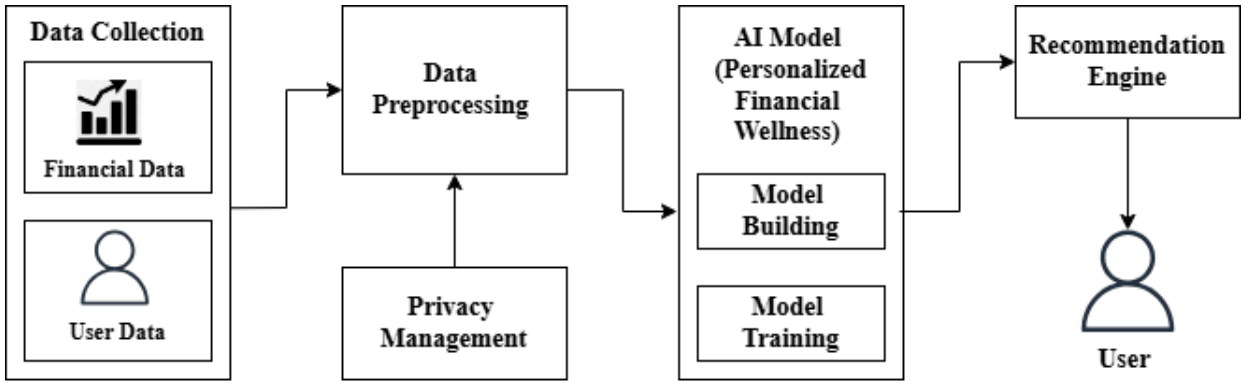

Figure 1: Block Diagram of the Proposed System

This study adopts a structured approach to develop proposed system using following these major steps:

- Data Collection: This study takes the combination of publically accessible financial datasets as well as user provided data to understand users' financial behavior. Trustworthy repositories will provide public datasets that contain market trends and spending habits. User provided data includes age, income, and financial goals which will be collected via surveys or usage of the platform. Ethical, legal standards and relevant privacy compliance will be followed when it comes to data collection and processing, including the General Data Protection Regulations (GDPR).
- Data Preprocessing: The raw data that has been provided will be vetted to determine if it is accurate, consistent, and suitable for analysis. This stage includes eliminating errors, removing duplicates and normalizing the values for consistency with the user data privacy mechanisms. Moreover, key characteristics relevant to the analysis will be identified in order to make the decision making process more effective.
- Privacy Preservation: Measures will be implemented using privacy preserving technique to maintain privacy of sensitive data of user throughout the entire process to prevent unauthorized access or misuse.
- Model Development and Training: An AI-driven model is to be developed to generate personalized investment strategies using advanced Artificial Intelligence techniques. The model will be trained using financial data to identify patterns and generate reliable recommendations.

- Recommendation Engine: The recommendation engine will provide personalized investment strategies to users. It will use the user's financial data to design specific investment strategies. This engine will enable the personalization feature of the platform and will provide users with personalized insights about investments according to what they want to achieve based on financial goals and financial situations.
- User Interface: An intuitive user interface (UI) will be developed with a focus on user friendly design and functionality. It will include an easy-to-navigate interface that caters to users with varying levels of financial literacy. The system will provide personalized recommendations aligned with users' financial goals and preferences, ensuring a seamless user experience.

Expected Results/Outcomes

- Identification of Financial Patterns: Identification and categorization of patterns in users' financial data such as income, financial goals, and investment preferences.
- Privacy Preservation: Secure processing of user data using privacy preserving technique to protect sensitive financial information.
- Personalized Investment Strategies: Development of an AI model to generate personalized investment strategies tailored to individual financial data.
- User Experience Evaluation: Evaluation of the platform's intuitiveness and accessibility in financial planning for users of all financial literacy levels.

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